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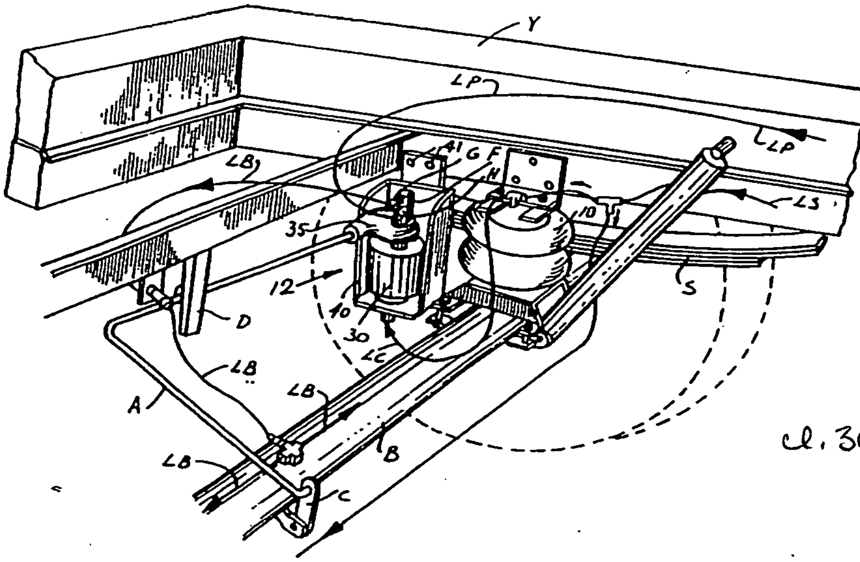

cl. 36, 37, 38, 39

(57) Abstract

A conventional suspension system includes a load sensing valve (F) for modulating the braking force with load. An auxiliary suspension system includes air bags (10, 11) for the rear axle (B) of the vehicle. To compensate for the effect of the air bags (10, 11) compensating means (12) is provided to move the stem (32) (V) of the valve (F). The compensating means (12) is pneumatically operated from the same air supply (L_s) as to the air bags (10, 11). The compensating means (12) in one case comprises an auxiliary compensating bellows (30) mounted on a bracket (40) below the valve (F). In another arrangement the compensating means (12) is provided by a ram (65) which acts on an extension arm (67) which in turn is mounted to an arm (M) which acts on the stem (V) of the load compensating valve (F).

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"Improvements in and relating to auxiliary suspension systems"

The invention relates to auxiliary suspension systems for vehicles, particularly light commercial vehicles and the like.

A vehicle braking system is designed to stop a fully laden vehicle travelling at a given speed within a specified distance. Consequently, some braking systems are over-designed for a vehicle when it is less than fully laden. This can create an undesirable situation when the load variation applies to one axle of the vehicle but not to the other. This is usually the case with commercial vehicles where the weight carried by the front axle is usually relatively constant whereas the weight carried by the back axle is considerably dependent on the condition of lading. Thus, when a commercial vehicle is unladen the braking system is not as efficient as when the vehicle is laden.

In an effort to overcome this difficulty it is known to provide load sensing and modulating means to modulate the braking force applied to the axles of commercial vehicles depending on the lading conditions of the vehicle. This gives a graduated brake output depending on the laden conditions of the vehicle. Generally, such load sensing and modulating means are used in association with vehicles equipped with conventional steel springs, usually steel

leaf springs. Typically, a load sensing valve for use with steel springs is fixed to the vehicle chassis at a location roughly above the back axle. The valve has an inlet from the brake pedal of the vehicle and an outlet which leads to the pneumatic or hydraulic brake actuators of the vehicle. In one case the load sensing valve is operated by a torsion bar which is rigidly fixed to the axle by means of a connecting link. The other end of the torsion bar acts against the stem of the load sensing valve to modulate the flow of braking fluid, and hence the braking force generated, to the laden conditions of the vehicle. When the vehicle is fully laden the torsion bar is pushed upwards relative to the vehicle chassis to fully open the valve so that full braking pressure is allowed to pass through the load sensing valve unchecked for maximum braking. When the vehicle is unladen, however, the body of the vehicle rises up on the suspension springs, pulling the torsion bar downwards relative to the chassis and partially closing the load sensing valve to reduce the braking pressure applied to the brakes.

In the case of light commercial vehicles such as small vans, ambulances, campers, mini coaches, four-wheel drive vehicles and the like, it is often desirable to provide an auxiliary suspension system in addition to the conventional steel spring suspension system of the vehicle. The auxiliary suspension system often comprises air bags for one or both of the vehicle axles. The air bags improve the handling and comfort of the vehicle throughout the loading range. However, there is a potential difficulty with such auxiliary air bag suspensions in that as the air bags are inflated the loading of the vehicle is shared between the air bag auxiliary suspension system and the conventional steel spring suspension system. The load sensing and modulating arrangement, however, only detects a partially laden

condition due to the air bags applying additional lift and load bearing support to the vehicle over and above the existing steel spring suspension. Consequently, the brake load sensing valve gives a less than normal brake fluid output to the brakes. Because of this error it is generally not possible to fit such an auxiliary air bag suspension system to this type of vehicle and still comply with the requirements of the regulatory authorities governing vehicle safety.

There is therefore a need for an improved suspension system which will overcome this difficulty.

According to the invention there is provided an auxiliary suspension system for a vehicle suspension system, the vehicle suspension system being of the type comprising:-

a suspension unit for each wheel, at least on the rear axle of the vehicle,

a load sensing and modulating means for modulating the braking forces applied by the vehicle brakes in accordance with load,

the auxiliary suspension system comprising:-

an auxiliary suspension unit for each wheel of at least the rear axle of the vehicle, and

compensating means for operating the load sensing and modulating means in response to the operation of the auxiliary suspension unit(s).

In a particularly preferred embodiment of the invention, the load sensing and modulating means includes a load compensating valve means for controlling the flow of

braking fluid and hence the braking forces applied in accordance with load. Preferably, the compensating means comprises an actuator which acts on the valve means to operate the load compensating valve means substantially in direct proportion to the position of the auxiliary suspension units.

In a particularly preferred embodiment of the invention the actuator is a pneumatic actuator.

Preferably, the actuator comprises an auxiliary bellows having an actuating arm engageable with an actuating stem of the load compensating valve means.

In one embodiment of the invention the actuating arm of the auxiliary bellows is arranged substantially co-axially with the actuating stem of the load compensating valve.

In a particularly preferred arrangement a shielding boot is provided over the connection between the auxiliary bellows and the load compensating valve.

In a particularly preferred embodiment of the invention, the auxiliary bellows is supported on a bracket which in turn supports the load sensing valve.

In another embodiment of the invention the actuator comprises an actuating ram which acts on the load sensing valve means.

Preferably the actuating ram includes a plunger which moves an arm associated with the load sensing valve means.

In a preferred arrangement the compensating means includes an extension arm which is interposed between the load sensing valve arm and the plunger of the actuating ram.

In one case the actuating ram is mounted to the vehicle chassis. Preferably the actuating cylinder is pneumatically operated. Most preferably the air supply to the pneumatic ram and the associated auxiliary suspension unit is from a common supply.

In one embodiment of the invention, the auxiliary suspension units comprise pneumatically operated bellows type suspension units.

In this case preferably compressed air is applied to the auxiliary suspension units and the compensating means from a common source so that the actuator mimics the operation of the auxiliary suspension units in all conditions of lading.

The invention also provides compensating means for operating a load sensing and modulating means in response to the operation of auxiliary suspension units wherein the compensating means comprises an actuator which acts on a load compensating valve means to operate the load compensating valve means substantially in direct proportion to the position of auxiliary suspension units. Most preferably, the actuator is a pneumatic actuator. In one case the actuator comprises an auxiliary bellows having an actuating arm for engagement with an actuating stem of the load compensating valve means. Preferably, the actuating arm of the auxiliary bellows is arranged substantially coaxially with the actuating stem of the load compensating valve.

In another embodiment of the invention the actuator comprises an actuating ram which acts on the load sensing valve means. Preferably the actuating ram includes a plunger which moves an arm associated with the load sensing valve means. In this case preferably the

compensating includes an extension arm which is interposed between the load sensing valve arm and the plunger of the actuating ram.

The invention will be more clearly understood from the following description thereof given by way of example only with reference to the accompanying drawings, in which:-

Fig. 1 is a diagrammatic view illustrating the operation of a load compensating valve of a conventional vehicle suspension system;

Fig. 2 is a schematic view of an auxiliary suspension system according to the invention;

Fig. 3 is a perspective view of the auxiliary suspension system in use with no compensating means in position;

Fig. 4 is a perspective view similar to Fig. 3 with the compensating means in position;

Fig. 5 is an elevational view of the auxiliary suspension system, in use;

Fig. 6 is a plan view of the auxiliary suspension system, in use;

Fig. 7 is a front view of a compensating means of the auxiliary suspension system;

Fig. 8 is a more detailed front view of the compensating means and load sensing valve;

Fig. 9 is a side view of the compensating means and load sensing valve;

Fig. 10 is a front, partially cross sectional view of a detail of the compensating means and load sensing valve;

Fig. 11 is a side view of the detail of Fig. 10;

Fig. 12 is a graph illustrating the braking pressure applied dependent on the laden conditions of the vehicle;

Fig. 13 is an elevational view of another suspension system;

Fig. 14 is an elevational view similar to Fig. 13 with another auxiliary suspension system according to the invention in use;

Fig. 15 is a perspective view of the auxiliary suspension system of Fig. 14 in use, and

Fig. 16 is a graph illustrating the braking pressure applied dependent on the laden conditions of the vehicle.

Referring to the drawings and initially to Figs. 1 to 3 a conventional load sensing and modulating means for modulating the braking forces applied to the brakes of a vehicle in accordance with load of a commercial vehicle is illustrated. The vehicle in this case has a suspension system of the type used in a Fiat Ducato. The vehicle has a conventional leaf spring suspension S. The load sensing and modulating means comprises a torsion bar A which is rigidly fixed by means of a connecting link C to the rear axle B of the vehicle. The torsion bar A is pivotally mounted about a pivot point D and acts against the stem E

of a load sensing valve F mounted on a vehicle chassis Y. The load sensing valve F has an inlet connection G, to which braking fluid is applied along line L_p on operation of the brake pedal of the vehicle, and an outlet connection H along line L_B to pneumatic or hydraulic brake actuators of the vehicle. The degree of modulation of the load sensing valve F with load is set by means of a setting arm (not shown) which may be moved to any position through an arc by the connecting link C which is attached at it's upper end to the end of the setting arm and at it's lower end to the rear axle B of the vehicle.

It will be apparent that when the vehicle is fully laden, the torsion bar A will be pushed upwards relative to the vehicle chassis Y and any braking pressure is allowed to pass directly through the load sensing valve F unchecked. When the vehicle is unladen, the body of the vehicle will rise on the suspension springs S pulling the torsion bar A downward relative to the chassis Y and causing any braking pressure applied to the inlet connection G of the load sensing valve F to be modulated before it passes to the brake actuators. As the weight is increased, the torsion bar pivots at the pivot point D and acts against the stem E of the valve F opening the valve F further and allowing more braking fluid to flow to the brakes to increase the braking pressure.

Referring to Figs. 2 and 3, there is illustrated an auxiliary suspension system which may be retro-fitted to a conventional commercial vehicle having a leaf spring suspension system S and a load sensing and modulating means as described above.

The auxiliary suspension system includes an auxiliary suspension unit, in this case, air operated bellows or air bags 10, 11 for the wheels of the rear axle B of the

vehicle. Compressed air for operating the bellows 10, 11 is supplied from an air reservoir 15 which is fed from a compressor 16. Air lines deliver compressed air from the air reservoir 15 to the bellows 10, 11 along lines L_s through an air control panel 19 and gauge 20. In this case the air system includes a spur air line 25 which may be used for auxiliary purposes such as for inflation of tyres.

Referring to Fig. 3 a vehicle suspension system with an auxiliary air bellows 10 in position is illustrated. In this arrangement the load sensing valve F does not operate correctly. This is because when the bellows 10 are inflated the vehicle chassis Y rises relative to the axle B. The torsion bar A will be pushed downwardly relative to the chassis Y behaving as if the vehicle is unladen. Thus, the load sensing valve F will not modulate the braking pressure.

According to the invention, compensating means indicated by interrupted lines in Fig. 2 and generally by the reference numeral 12 operate the load sensing valve F in response to the operation of the auxiliary air bellows suspension units 10, 11.

It will be noted that air is delivered to the load compensating means 12 along a spur line L_c from the same air line L_s which is used to supply air to the bellows 10, 11. In this way, the air supplied to the bellows 10, 11 is mimicked by that supplied to the compensating means 12. Thus, the compensating means 12 mimics the operation of the bellows 10, 11 in substantially all conditions of use.

Referring particularly to Figs. 4 to 11, the compensating means 12 in this case comprises a pneumatic actuator in the form of an auxiliary compensating bellows 30 having an

actuating arm 31 engageable with an actuating stem 32 of the load compensating valve F. The actuating arm 31 of the auxiliary bellows 30 is arranged coaxially with the actuating stem 32 of the load compensating valve F and a shielding boot 35 is provided over the connection between the auxiliary bellows 30 and the load compensating valve F. It is important to protect the lower end of the load compensating valve F inside a moulded rubber boot 35 to prevent road dirt from reaching the valve F.

In more detail the connection between the actuating arm 31 and valve stem 32 comprises a plunger 46 and a spacer 47 (see particularly Fig. 10). The spacer 47 screws into a top plate 45 of the air bag 30 and an 8 mm hole is drilled into the rubber boot 35 to allow the plunger 46 to pass through the spacer 47. The plunger 46 acts against the stem 32 of the load sensing valve F.

The auxiliary air bellows 30 in this case is a compact short stroke air bag such as a FIRESTONE IMIA air bag.

The auxiliary bellows 30 is supported on a bracket 40 having mounting holes 41 which are used to attach the load sensing valve F to the bracket 40 and to the chassis of the vehicle as illustrated in Fig. 4.

There are many advantages of this arrangement, for example, because the auxiliary bellows 30 is located directly below the valve F and the actuating arm 31 is arranged substantially coaxially with the stem 32 of the valve F the minimum space is required. Further, the maximum force may be applied by the auxiliary bellows 30 over the shortest distance. A neat, reliable and simply fitted and operated compensating unit is provided without interfering with the vehicle suspension system. The unit can be readily fitted by disconnecting the valve F from

its mounting, fitting a bracket to the same mounting and connecting the auxiliary bellows 30 to the bracket.

To shield the connection between the air line L_c and the auxiliary bellows 30 the bracket 40 is preferably extended downwardly over this connection.

Example 1

A pair of FIRESTONE type 224 pneumatic bellows were fitted as auxiliary suspension units to the rear axle of a Fiat Ducato commercial vehicle. A compensating means 12 was installed as described above to operate the load sensing valve F in response to operation of the auxiliary suspension bellows 10, 11. The breaking pressure supplied to the rear brakes was checked at various ladings and the following results were obtained at different inflation pressures in the auxiliary suspension bellows.

TABLE 1: Braking pressure (bar) with rear axle load (Kg) for Fiat Ducato.

Auxiliary Bellows Inflation Pressures (psi)	0	10	20	30	40
Rear Axle Load (kg)	Breaking Pressure (Bar)				
1300	88	89	88	84	86
1420	98	98	98	97	90
1520	105	106	105	103	100
1635	112	114	112	111	110

These results are plotted in Fig. 12.

As the auxiliary suspension bellows inflation pressure increases from 0 (no bellows fitted) the response of the braking pressure closely matches that of the normal braking pressure with no auxiliary suspension bellows fitted. Thus, when the auxiliary suspension system

incorporating a compensator as described above is used, the vehicle braking system operates correctly and safely to manufacturer's settings. Thus, there is no adverse effects on the braking system by installing the auxiliary air bag suspension system of the invention.

Referring to Fig. 13 there is illustrated another conventional suspension system between a chassis Y and an axle B, in this case of a Ford Transit F120 commercial vehicle. Parts similar to the arrangement of Fig. 3 above are assigned the same reference numerals. The suspension is a conventional leaf spring suspension S which extends between the axle B and chassis Y. A load sensing valve F is mounted on the chassis Y and includes a fluid inlet G, a fluid outlet H and a valve stem V which is diagrammatically illustrated. An arm M is pivotally mounted at P to the body of the valve F. An extension V^1 of the valve stem V engages the arm M as illustrated. A main setting coil spring N extends between one free end of the arm M and the axle B and a return spring Q extends between the other free end of the arm M and a fixed mounting R. In use, when the vehicle is fully laden the arm M is in the position illustrated in Fig. 13 with the valve stem V in a lowered position allowing free flow of braking fluid through the valve F. As the load is removed the chassis Y moves upwardly and the arm M pivots about the pivot P against the biassing of the spring N. This causes the valve stem V^1 to move upwardly to modulate the flow of fluid through the valve V.

Referring to Figs. 14 and 15 there is illustrated an auxiliary suspension system according to the invention comprising an auxiliary air bellows 10 for the wheels on either side of the rear axle B. The bellows 10 is

connected between the chassis and the axle B as illustrated. The air bellows 10 has an inlet connection 61 to which an air line L_s is connected for inflation of the bellows 10. Compensating means for modulating the operation of the load sensing valve F comprises a pneumatic cylinder 65 having a plunger 66 which is attached to an extension arm 67 bolted to the arm M for the stem V^1 of the load sensing valve F. The body of the cylinder 65 is fixed to a side rail 68 of the chassis Y as illustrated. The air supply L_c to the cylinder 65 is from a common supply which also provides air for the bellows 10 along the line L_s.

In use, as the bellows 10 is inflated to raise the chassis Y relative to the axle B air is also supplied to the cylinder 65 which lifts the plunger 66 and the extension arm 67. The extension arm 67 in turn lifts the arm M of the load sensing valve F causing the stem V^1 to rise and restrict the flow of fluid through the valve F. In this way the load sensing valve F operates correctly to modulate the braking pressure in accordance with load regardless of the presence of the bellows 10.

There are many advantages of this arrangement. For example, the extension arm 67 and ram 65 is a simple, neat and effective way of providing a compensating means for the valve F. The vehicle suspension system or valve F is not interfered with. It is only necessary to mount the ram 65 to the vehicle chassis and to provide an extension arm 67 connected to the valve operating arm M. Air supply to the ram 65 is by a common air supply to the auxiliary suspension bellows 10 so that the operation of the ram 65 mimics the operation of the bellows.

Example 2

A pair of FIRESTONE type 224 pneumatic bellows were fitted as auxiliary suspension units to the rear axle of a Ford F120 Transit commercial vehicle. A compensating means 12 was installed as described above with reference to Figs. 14 and 15 to operate the load sensing valve in response to operation of the auxiliary suspension bellows 10. The breaking pressure supplied to the rear brakes was checked at various ladings and the following results were obtained at different inflation pressures in the auxiliary suspension bellows.

TABLE 2: Braking pressure (bar) with rear axle load (kg) for Ford F120 Transit.

Auxiliary Bellows Inflation Pressure (psi)	0	10	20	30	40
Rear Axle Load (Kg)	Braking Pressure (Bar)				
1645	128	132	128	128	126
1550	120	130	128	122	118
1415	124	122	120	118	116
1305	118	118	116	112	110
1170	112	108	104	98	96
1045	94	90	92	92	90
925	85	84	82	80	80
790	72	74	75	72	70
640	66	64	64	62	66
495	50	52	50	52	52

These results are plotted in Fig. 16.

It may be possible to compensate by using electronic level sensing devices, however, such electronic means is likely to be expensive and is generally unsuitable in the harsh environment of the underside of a commercial vehicle. In addition, a different design of load sensing valve may be required so that the unit may not be as easily retro-fitted to existing suspension systems as is the case in the present invention.

It will be appreciated that in some cases the auxiliary suspension units may be provided by a spring means such as a body of elastomeric material, a leaf spring (S), coil spring (S) or any combination therefor which may be hydraulically or pneumatically assisted.

Many modifications of the specific embodiments of the invention described will be readily apparent and accordingly the invention is not limited to the embodiments hereinbefore described which may be varied in both construction and detail.

CLAIMS

1. An auxiliary suspension system for a vehicle suspension system, the vehicle suspension system being of the type comprising:-

a suspension unit for each wheel, at least on the rear axle of the vehicle, and

a load sensing and modulating means for modulating the braking forces applied by the vehicle brakes in accordance with load,

the auxiliary suspension system comprising:-

an auxiliary suspension unit for each wheel of at least the rear axle of the vehicle, and

compensating means for operating the load sensing and modulating means in response to the operation of the auxiliary suspension unit(s).

2. An auxiliary suspension system as claimed in claim 1 wherein the load sensing and modulating means includes a load compensating valve means for controlling the flow of braking fluid and hence the braking forces applied in accordance with load.

3. An auxiliary suspension system as claimed in claim 2 wherein the compensating means comprises an actuator which acts on the valve means to operate the load compensating valve means substantially in direct proportion to the position of the auxiliary suspension units.

4. An auxiliary suspension system as claimed in claim 3 wherein the actuator is a pneumatic actuator.

5. An auxiliary suspension system as claimed in claim 4 wherein the actuator comprises an auxiliary bellows having an actuating arm engageable with an actuating stem of the load compensating valve means.

6. An auxiliary suspension system as claimed in claim 5 wherein the actuating arm of the auxiliary bellows is arranged substantially co-axially with the actuating stem of the load compensating valve.

7. An auxiliary suspension system as claimed in claim 5 or 6 wherein a shielding boot is provided over the connection between the auxiliary bellows and the load compensating valve.

8. An auxiliary suspension system as claimed in any of claims 5 to 7 wherein the auxiliary bellows is supported on a bracket which in turn supports the load sensing valve.

9. An auxiliary suspension system as claimed in claim 3 or 4 wherein the actuator comprises an actuating ram which acts on the load sensing valve means.

10. An auxiliary suspension system as claimed in claim 9 wherein the actuating ram includes a plunger which moves an arm associated with the load sensing valve means.

11. An auxiliary suspension system as claimed in claim 10 wherein the compensating means includes an

extension arm which is interposed between the load sensing valve arm and the plunger of the actuating ram.

12. An auxiliary suspension system as claimed in any of claims 9 to 11 wherein the actuating ram is mounted to the vehicle chassis.

13. An auxiliary suspension system as claimed in any of claims 9 to 12 wherein the actuating ram is pneumatically operated.

14. An auxiliary suspension system as claimed in claim 13 wherein the air supply to the pneumatic ram and the associated auxiliary suspension unit is from a common supply.

15. An auxiliary suspension system as claimed in any preceding claim wherein the auxiliary suspension units comprise pneumatically operated bellows type suspension units.

16. An auxiliary suspension system as claimed in claim 15 wherein compressed air is applied to the auxiliary suspension units and the compensating means from a common source so that the actuator mimics the operation of the auxiliary suspension units in all conditions of lading.

17. An auxiliary suspension system substantially as hereinbefore described with reference to Fig. 2 and Figs. 4 to 12 of the drawings.

18. An auxiliary suspension system substantially as hereinbefore described with reference to Figs. 14 to 16 of the drawings.

19. Compensating means for operating a load sensing and modulating means in response to the operation of auxiliary suspension units, wherein the compensating means comprises an actuator which acts on a load compensating valve means to operate the load compensating valve means substantially in direct proportion to the position of auxiliary suspension units.

20. Compensating means as claimed in claim 19 wherein the actuator is a pneumatic actuator.

21. Compensating means as claimed in claim 20 wherein the actuator is an auxiliary bellows having an actuating arm for engagement with an actuating stem of the load compensating valve means.

22. Compensating means as claimed in claim 21 wherein the actuating arm of the auxiliary bellows is arranged substantially coaxially with the actuating stem of the load compensating valve.

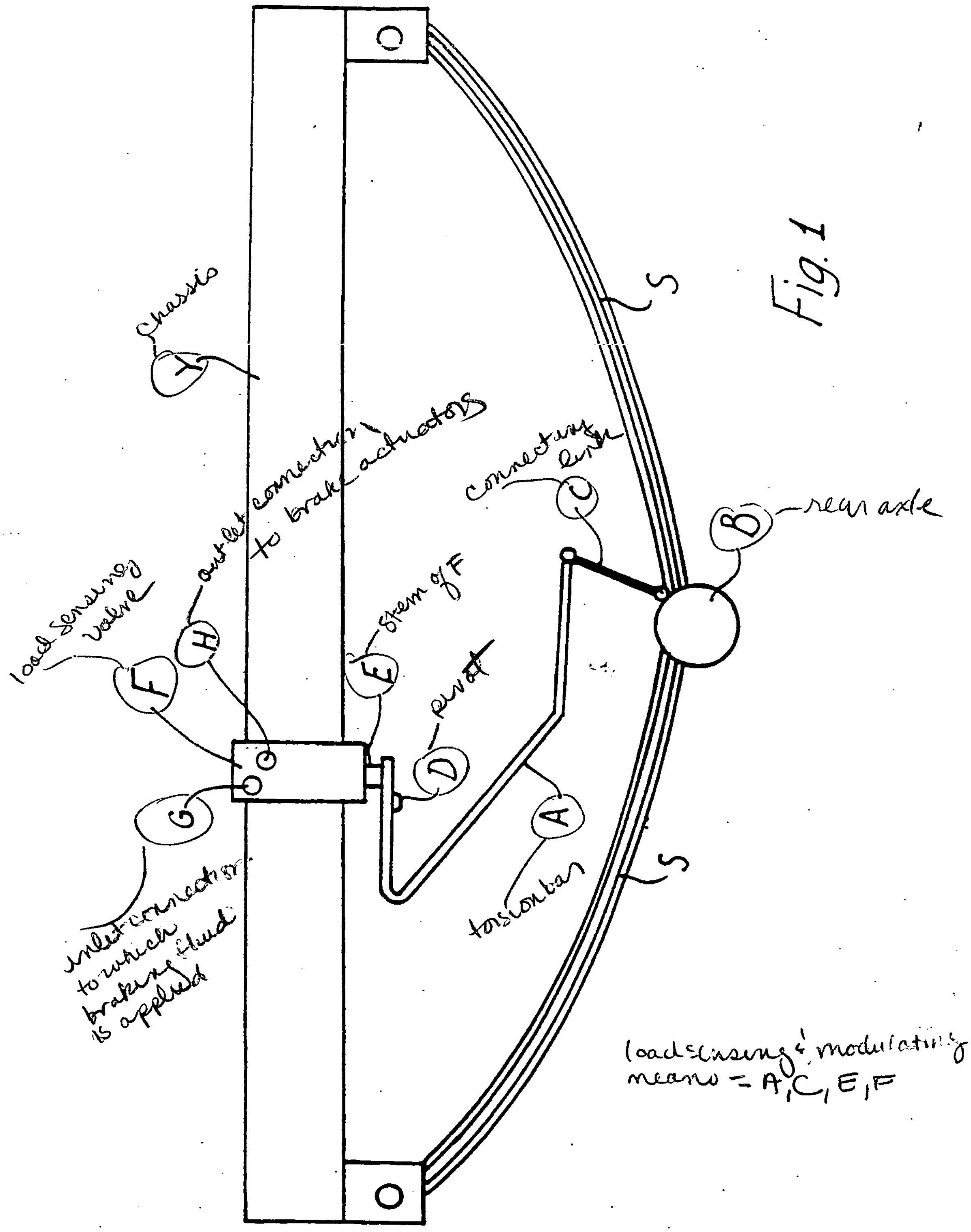
23. Compensating means as claimed in claim 19 and 20 wherein the actuator comprises an actuating ram which acts on the load sensing valve means.

24. Compensating means as claimed in claim 23 wherein the actuating ram includes a plunger which moves an arm associated with the load sensing valve means.

25. Compensating means as claimed in claim 24 wherein the compensating means includes an extension arm which is interposed between the load sensing valve arm and the plunger of the actuating ram.

26. Compensating means substantially as hereinbefore described with reference to Figs. 2 and Figs 4 to 12 of the drawings.

27. Compensating means substantially as hereinbefore described with reference to Figs. 14 to 16 of the drawings.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connecting link
C
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rear axle
outlet connection to brake actuators
load sensing valve
H
F
E
stem of F
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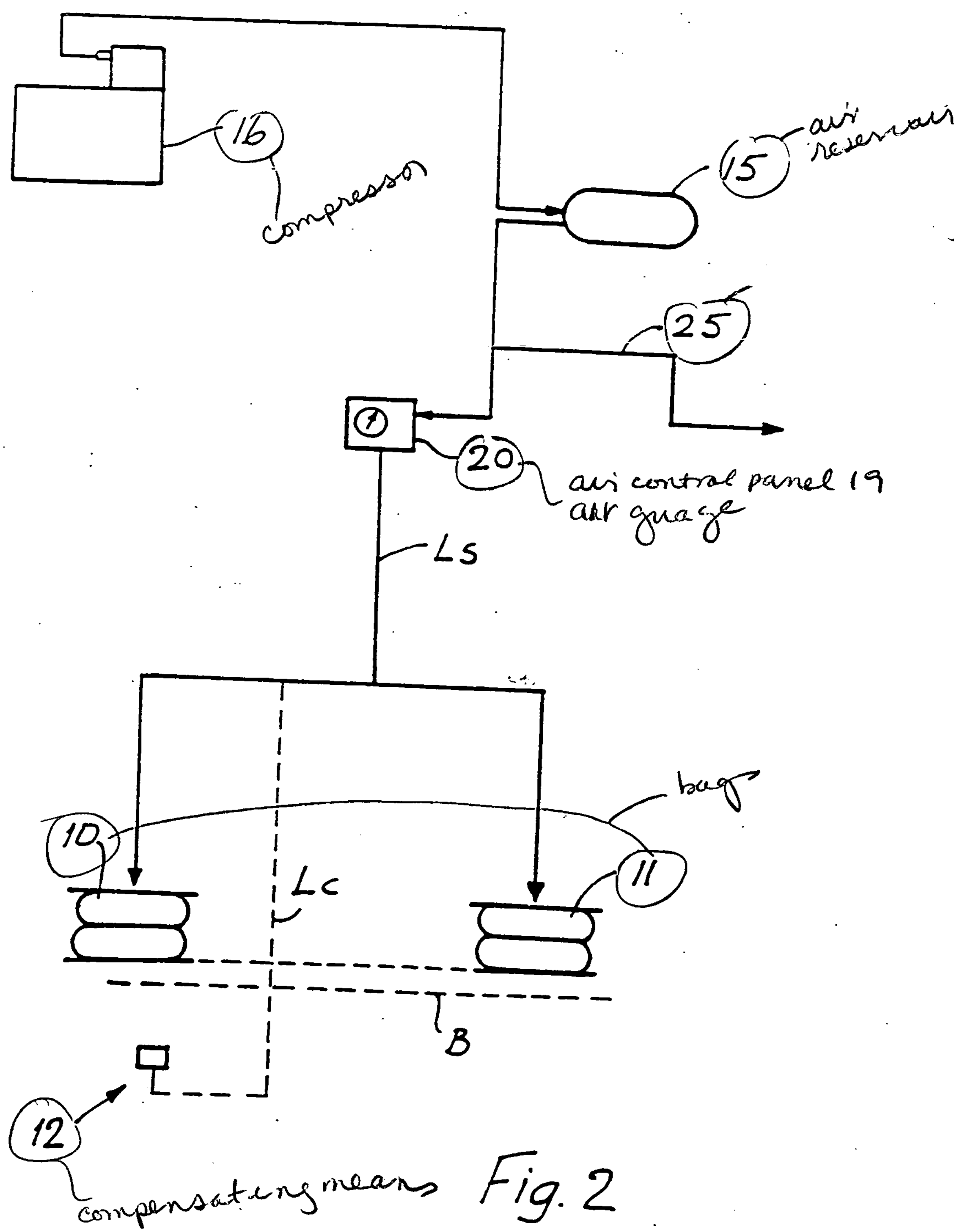
D
A
G
inlet connection to which braking fluid is applied
torsion bar
S
S
load sensing & modulating means = A, C, E, F

Fig.1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25
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20
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air guage
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bags
10
11
Lc
B
12
compensating means

Fig. 2

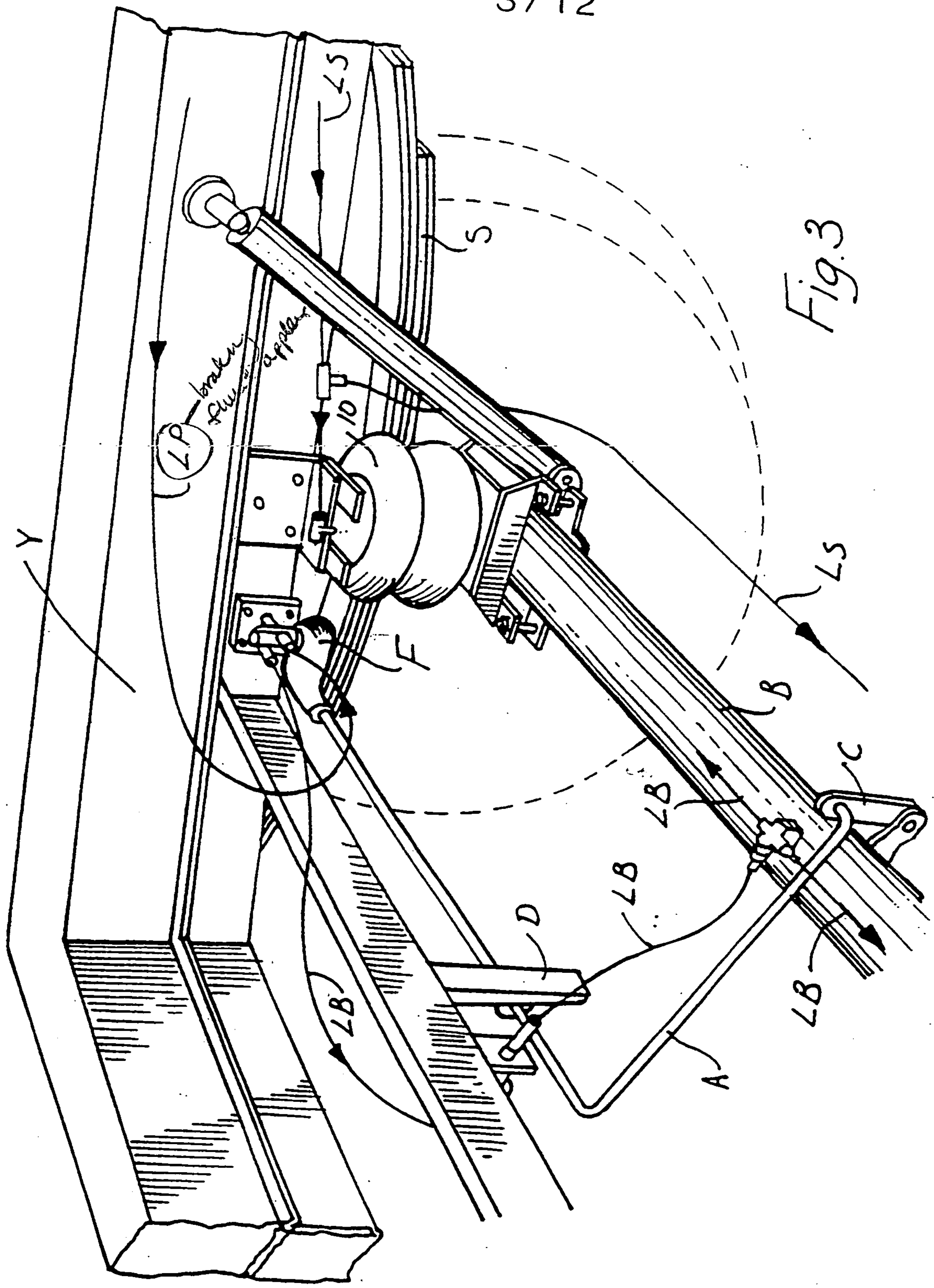
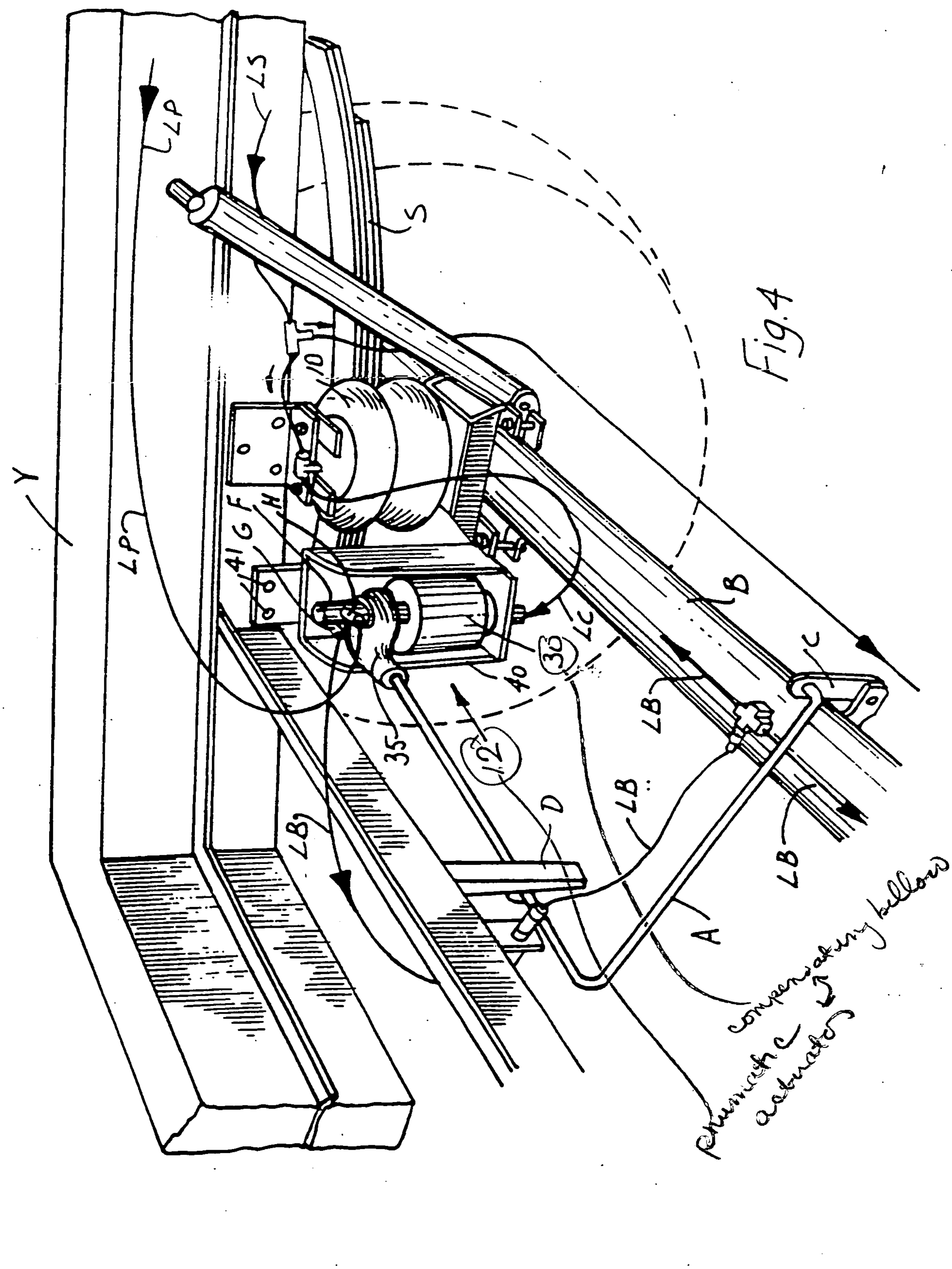


Fig.3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Y
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41
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40
36
35
12
D
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pneumatic actuator

Fig.4

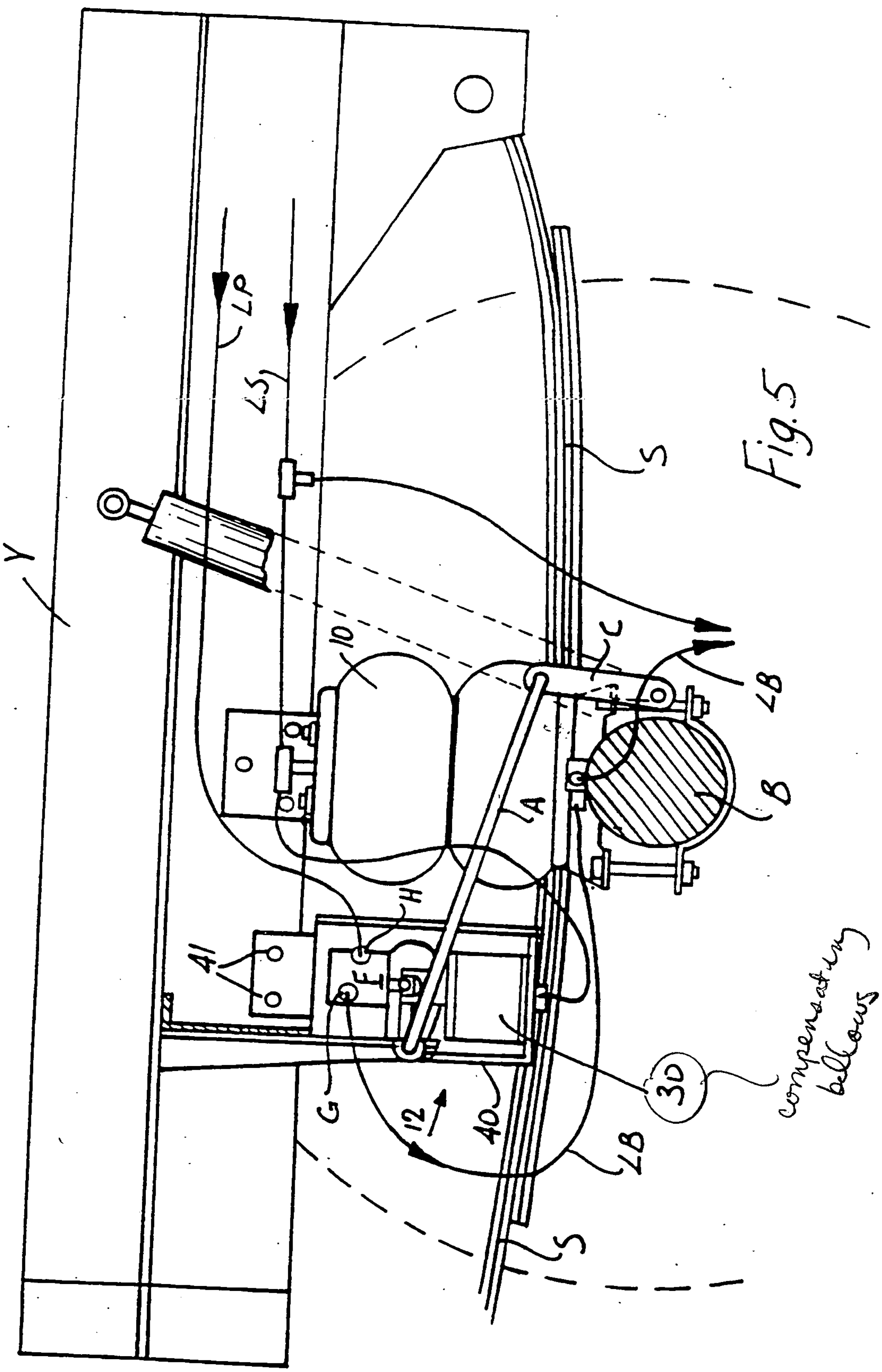

Fig.5

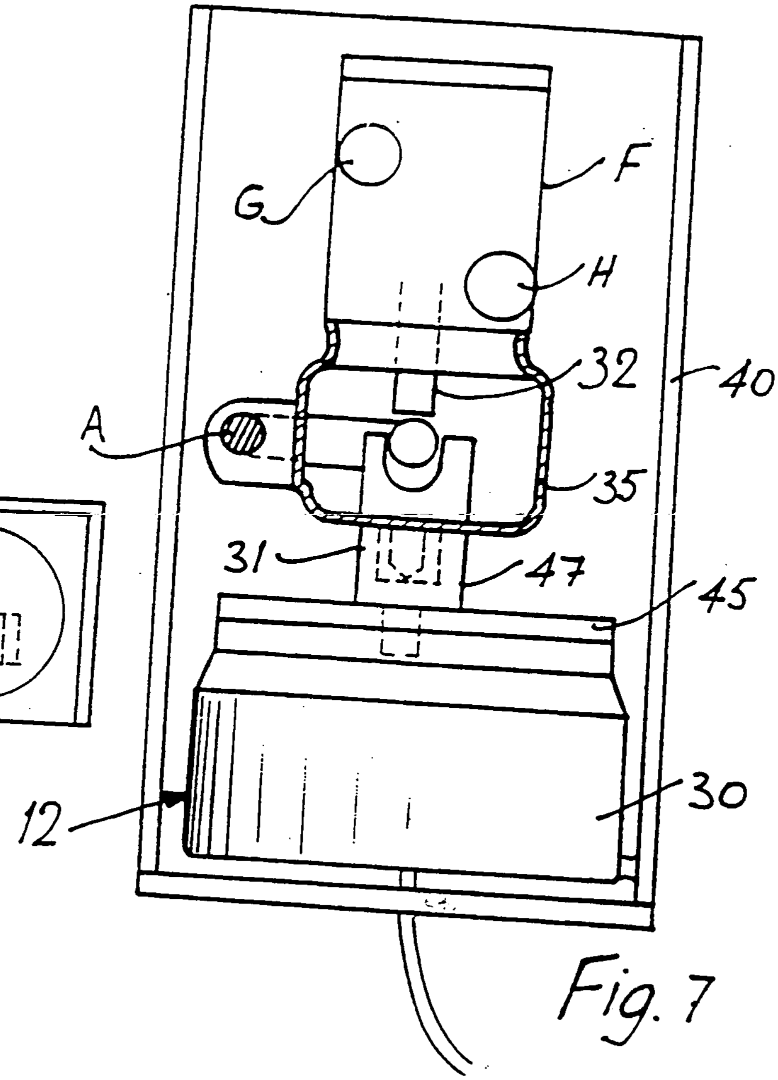

Fig. 7

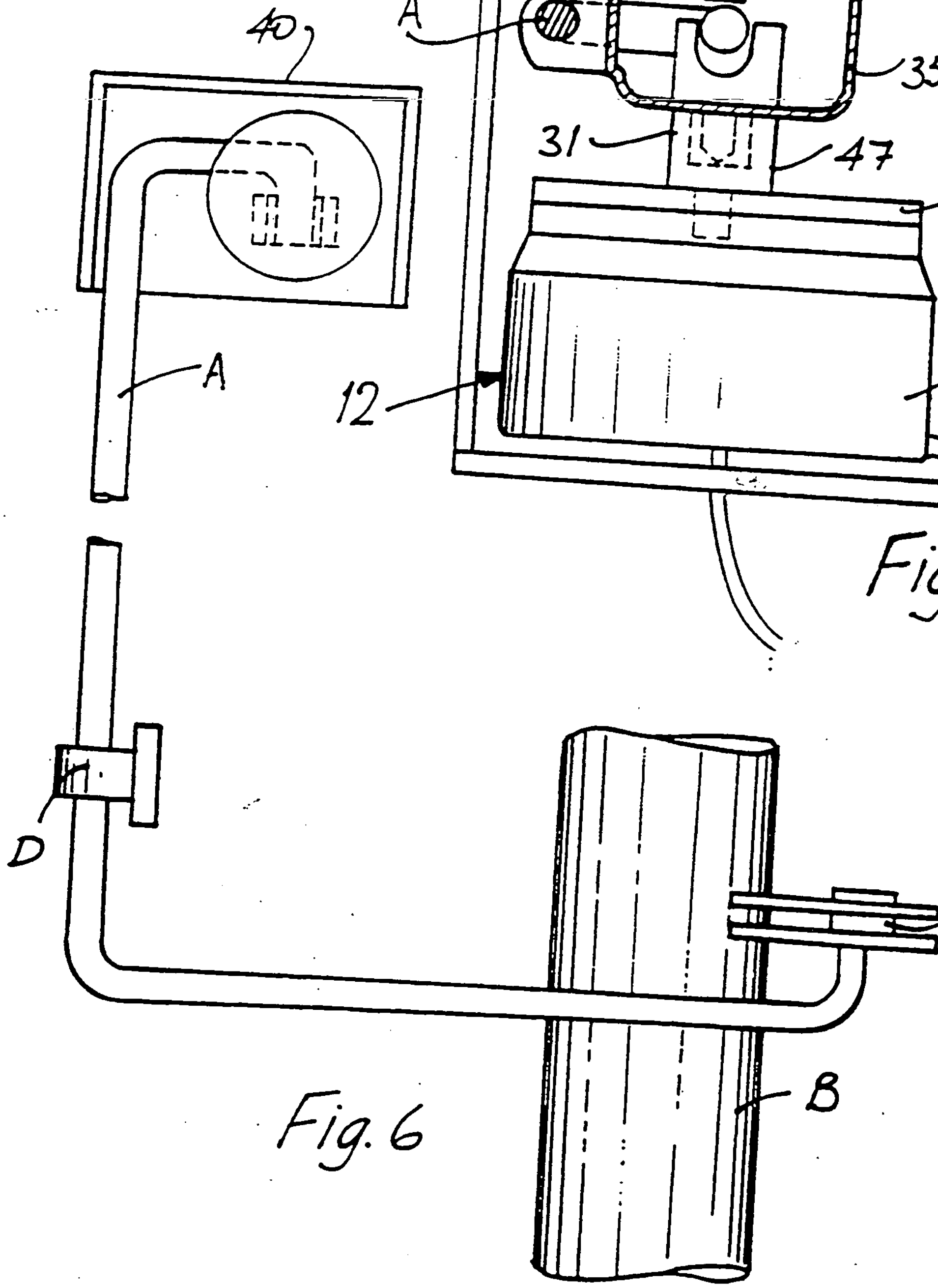

Fig. 6

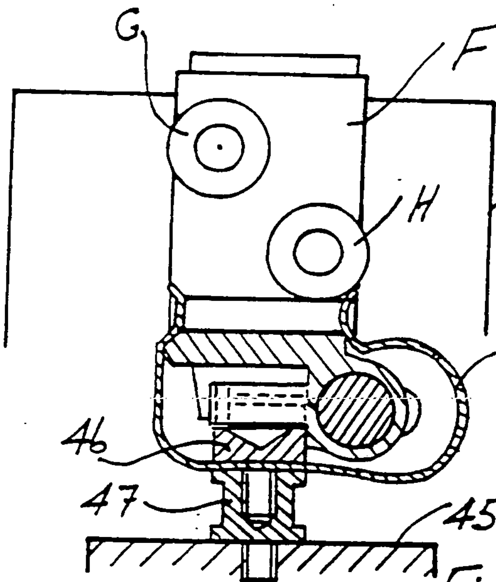

Fig.10

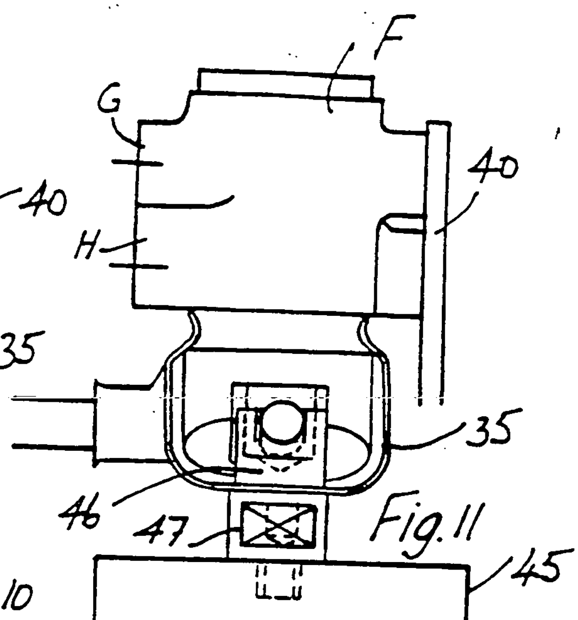

Fig.11

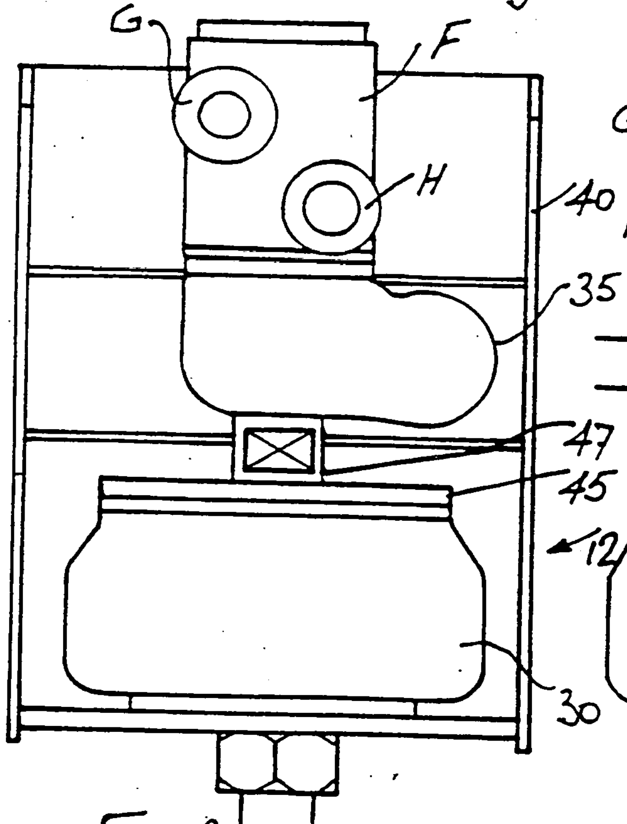

Fig.8

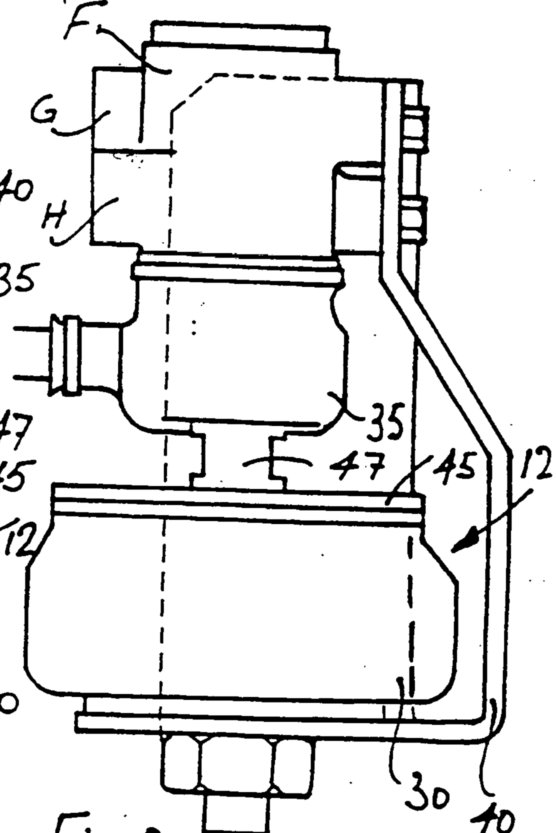

Fig. 9

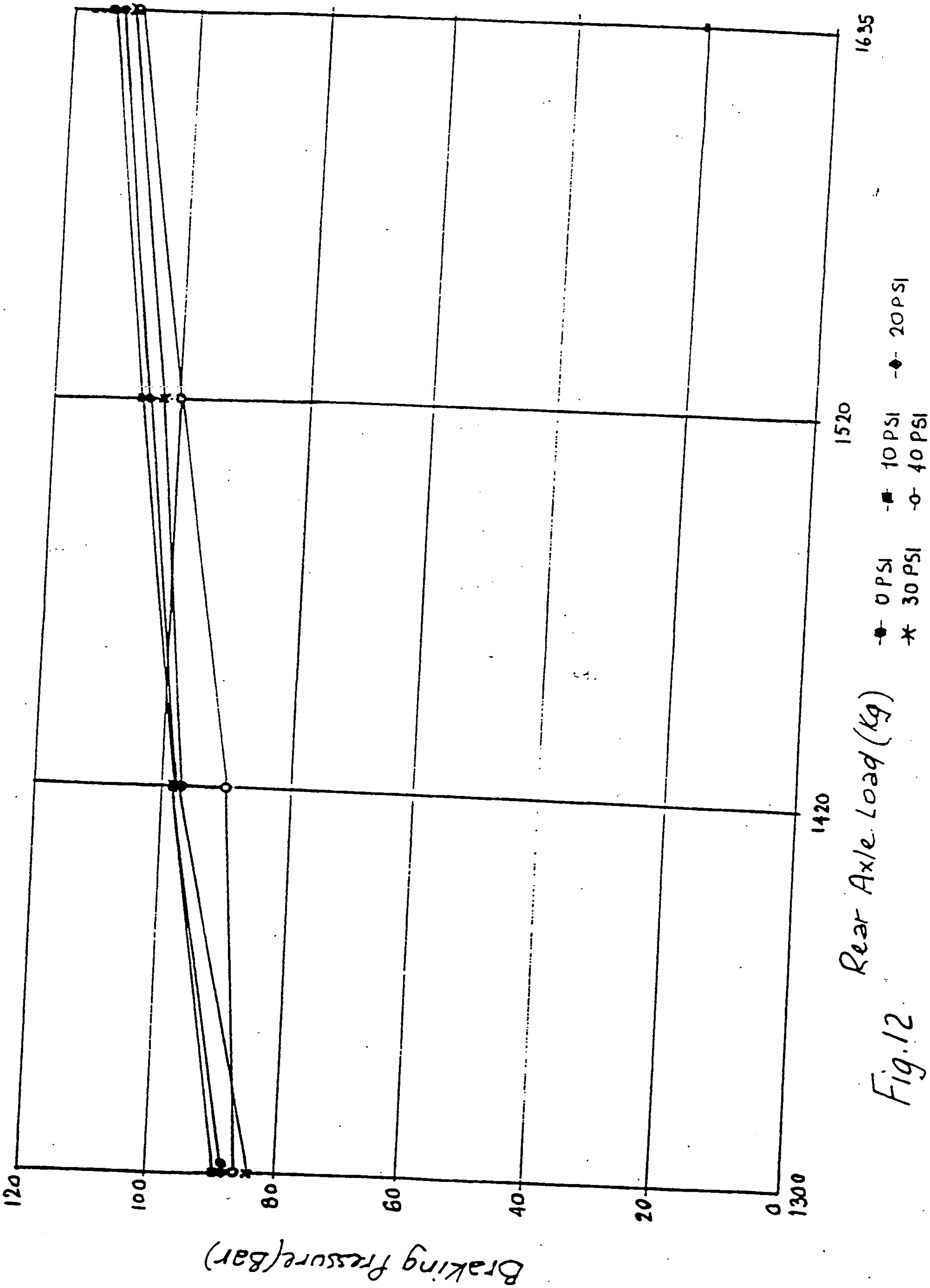
Braking Pressure (Bar)
120
100
80
60
40
20
0
1300
1420
1520
1635
Rear Axle Load (Kg)
0 PSI
10 PSI
20 PSI
30 PSI
40 PSI

Fig. 12

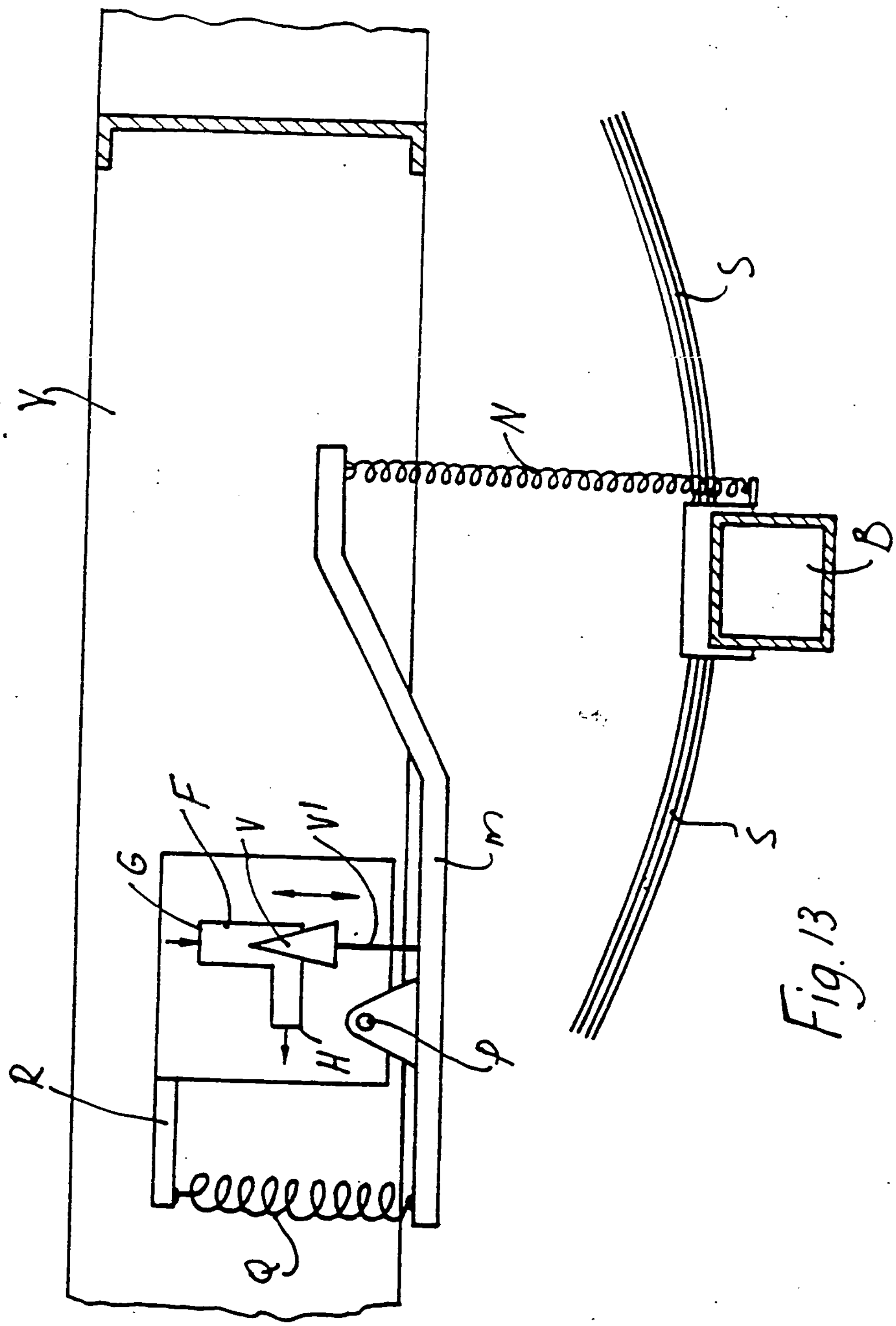

Fig. 13

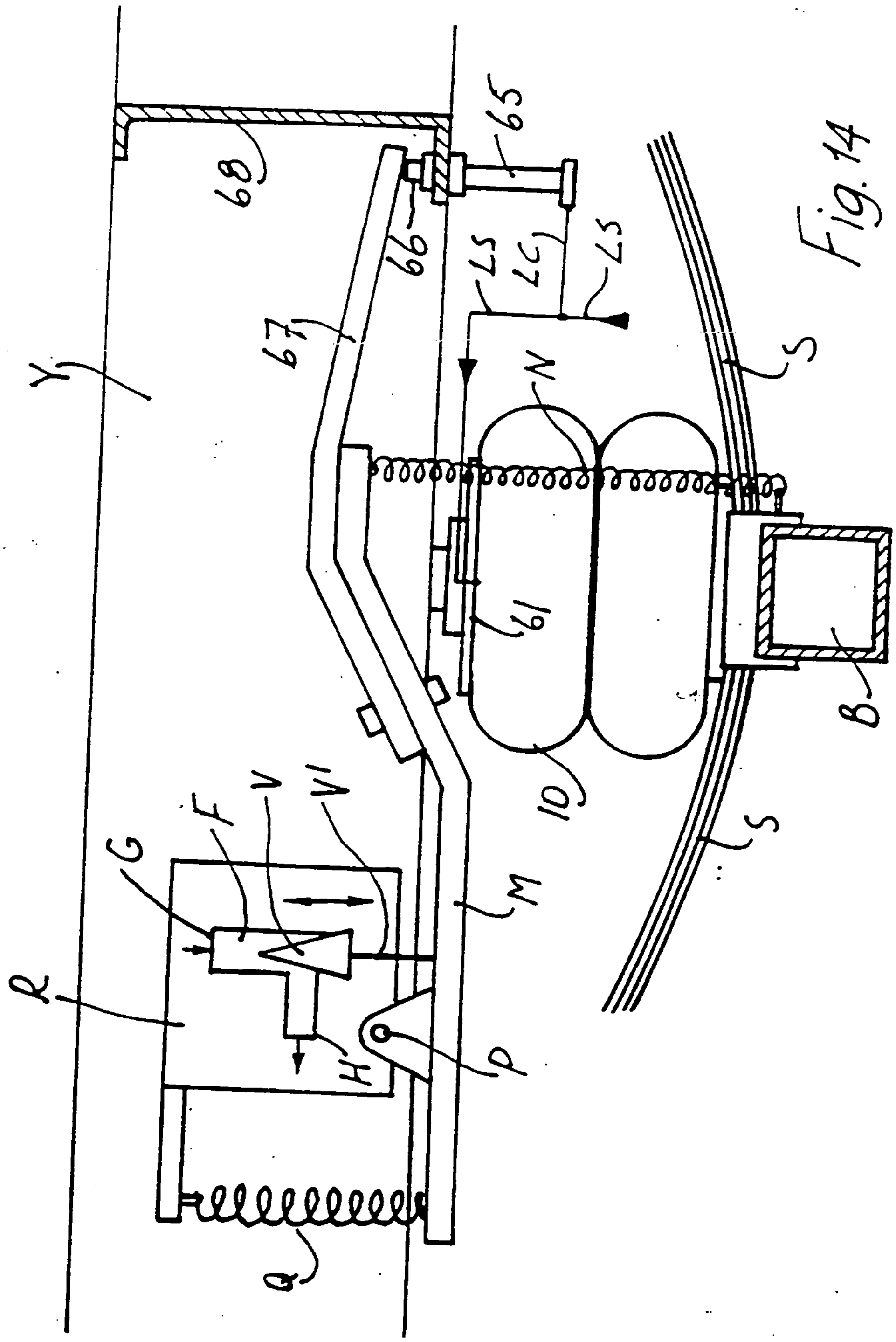

Fig. 14

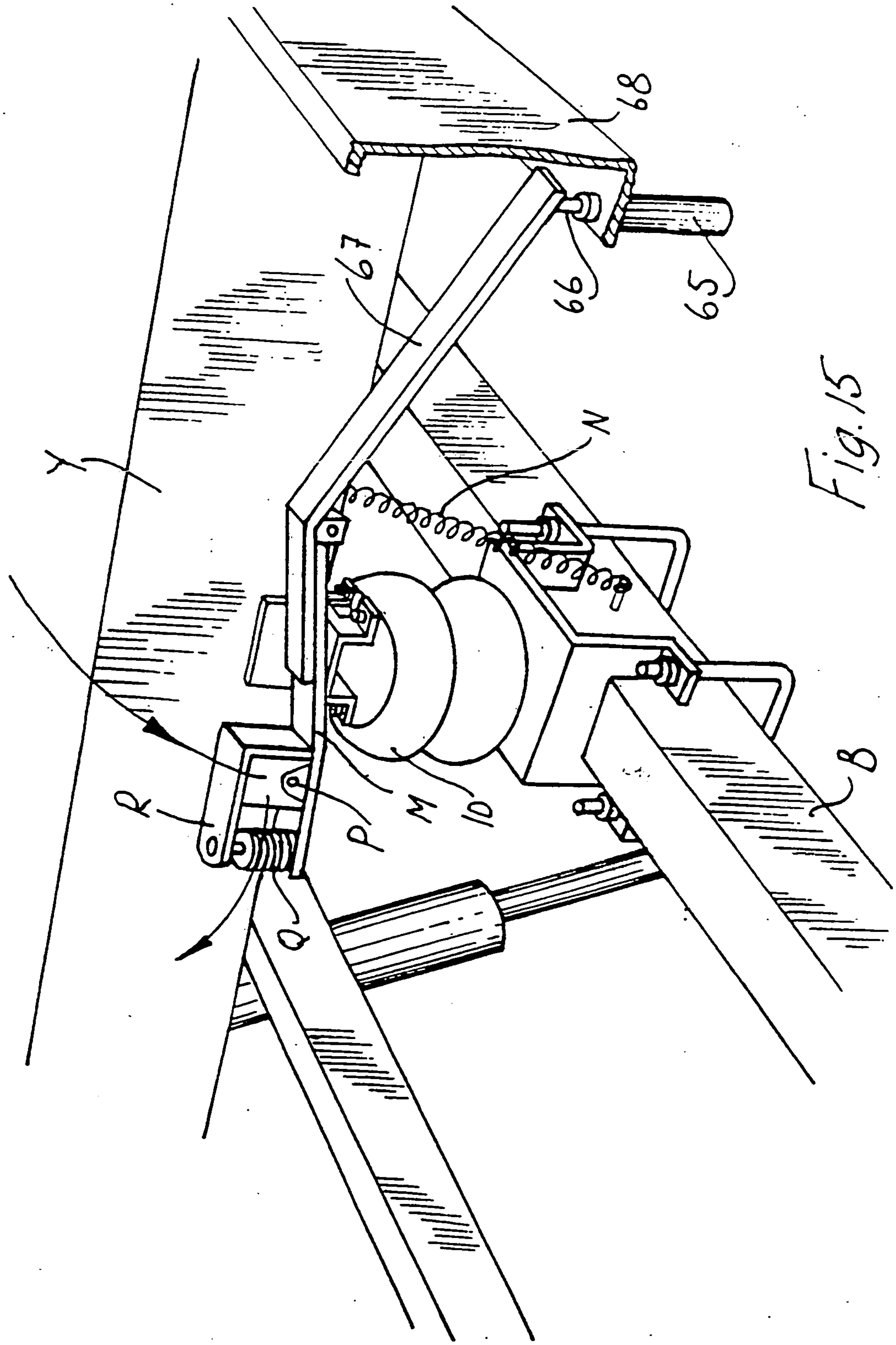

Fig.15

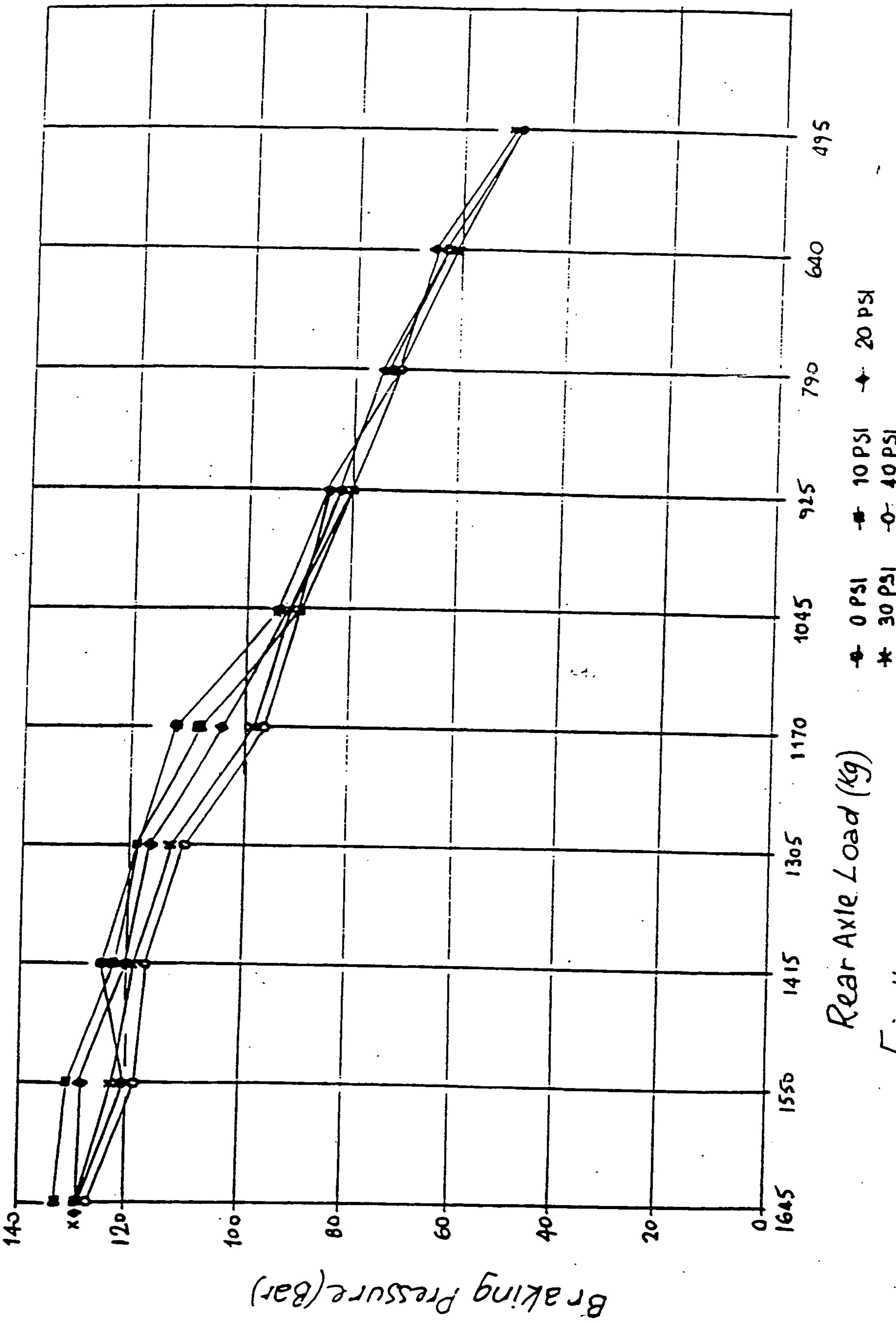
Braking Pressure (Bar)
140
120
100
80
60
40
20
0
Rear Axle Load (Kg)
1645
1550
1415
1305
1170
1045
925
790
640
495
0 PSI
10 PSI
20 PSI
30 PSI
40 PSI

Fig.16

INTERNATIONAL SEARCH REPORT

International Application No PCT/IE 93/00019

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 B60T8/18; B60G17/052; B60G11/46

II. FIELDS SEARCHED

Minimum Documentation Searched[7]	
Classification System	Classification Symbols
Int.Cl. 5	B60T ; B60G

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
X	EP,A,0 399 314 (BOSCH) 28 November 1990 see the whole document ---	1-4,15, 19,20
X	PATENT ABSTRACTS OF JAPAN vol. 8, no. 201 (M-325)(1638) 14 September 1984 & JP,A,59 089 257 (TOYOTA) 23 May 1984 see abstract	1,2,15, 16,19,20
A		3,4,9,23
X	--- DE,B,1 145 501 (WESTINGHOUSE BREMSEN-GESELLSCHAFT) 14 March 1963 see the whole document ---	1,2,15, 16,19

-/--

° Special categories of cited documents : [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
22 JUNE 1993	[illegible]
International Searching Authority	Signature of Authorized Officer
EUROPEAN PATENT OFFICE	TSITSILONIS L.

1

International Application No PCT/IE 93/00019.

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
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ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

IE 9300019
SA 71766

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information. 22/06/93

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		FR-A,B 2149351	30-03-73
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		NL-A- 7211051	20-02-73

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82